FEATURE

Incorporating the Land Data Assimilation System into...

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The Land Data Assimilation System (LDAS) team at NASA's Goddard Space Flight Center (GSFC) is developing a system to aid water resource managers in making flood and drought assessments and predictions. This system runs multiple land surface models, assimilating and using the latest surface observations and remotely sensed data as both operational and retrospective forcings. The emphasis of LDAS is on capturing the most realistic representations of land surface states and dynamics over large areas and at high resolutions. The main hydrometeorological variables on which LDAS focuses are soil moisture, evaporation, snow cover, runoff, precipitation, and surface energy budget variables.

The United States Bureau of Reclamation (Reclamation) relies heavily on accurate and timely hydrometeorological information for river basin management. More than 80 percent of the water supply in the West is provided by snowpack runoff, so to generate accurate flood forecasts, Reclamation must have accurate estimates of snow water equivalent and must be able to monitor the evolution of the snowpack into runoff. In addition to generating flood forecasts, Reclamation also requires the ability to predict the effects of drought conditions on agricultural production, on the public, and on wildfire vulnerability. To address these important issues, output from LDAS Land Surface Models (LSMs) can be integrated into the river basin decision support systems that Reclamation's managers routinely use to manage western river systems. Ultimately, using the LDAS LSM will improve overall flood and drought risk analysis and prediction.

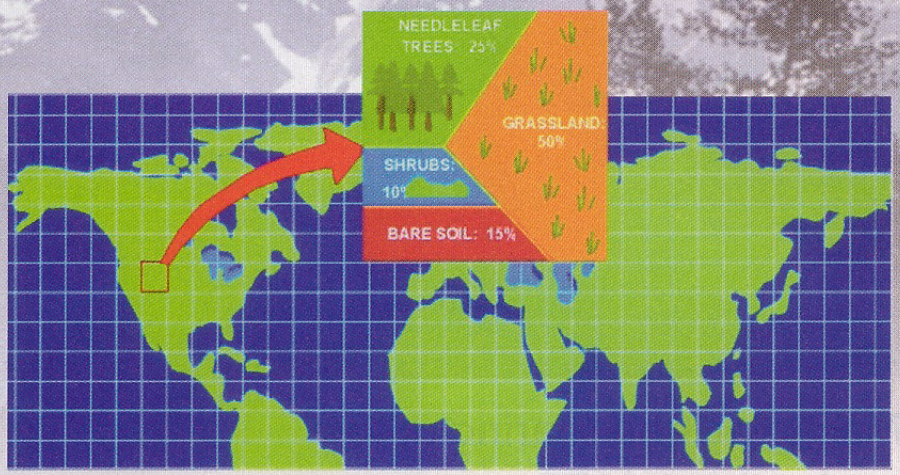

Figure 1. *The LDAS vegetation tiling system simulates subgrid scale variability by dividing each grid cell into a set of tiles based on the distribution of vegetation classes within the cell. Each tile represents one vegetation class and is weighted by the fraction of that class within the cell.*

LDAS Background

LDAS research efforts are divided between two main projects: North American LDAS (NLDAS) and Global LDAS (GLDAS). Both projects share the same underlying objectives: LSM development, use of observations as forcing data, and assimilation of different satellite and radar information. A few differences do exist between the two projects, but as the projects develop side-by-side they strengthen each other's growing utility for applications and atmospheric prediction models.

Overall, the NLDAS and GLDAS projects are characterized as real-time, distributed, uncoupled, land-surface simulation systems on a U.S. national domain at .125-degree resolution and on a global domain at .25-degree resolution. Both LDAS projects use a suite of different LSMs running in tandem on these grid systems and driven by common surface forcing.

Land Surface Models currently incorporated into LDAS include Mosaic, the National Centers for Environmental Prediction model, the Oregon State University model, the United States Air Force model, the Office of Hydrology model, and the Community Land Model. Additional LSMs being brought into LDAS include the Variable Infiltration Capacity model and the Catchment Land Surface Model.

Other major components of the LDAS projects include replacement of atmospheric model-based forcing with observations, assimilation of remotely

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sensed and *in-situ* measurements into the LSMs, and output validation and calibration of the LSMs. By using observations to drive land surface models, such as precipitation and radiation, biases present in coupled atmospheric-land surface model systems can be avoided.

In the NLDAS project, the modeled precipitation is replaced with a merged product consisting of Stage IV Weather Service Radar-88 Doppler, gauge precipitation, and modeled precipitation from the National Centers for Environmental Protection atmospheric Eta-based 4-D Data Assimilation System. Downward shortwave and longwave radiation products used are from GOES satellites. GLDAS also has replaced some of its modeled fields with satellite-derived precipitation, such as the NASA GSFC 3-hourly merged-satellite product, which includes geostationary infrared, Special Sensor Microwave/Imager, and Tropical Rainfall Measuring Mission data. As for radiation fields, GLDAS uses global downward shortwave and longwave radiation products from the Air Force Weather Agency.

LSMs are run over both LDAS domains using vegetation-based "tiles" to simulate variability below the scale of the model grid squares, with each tile representing an area covered by a given vegetation type. Both NLDAS and GLDAS use the 1-km University of Maryland vegetation classification scheme, which is based on the climatology of AVHRR remote sensing data. A near-real-time, satellite-based, leaf-area index derived from AVHRR and MODIS data is currently being used in some of the LSMs.

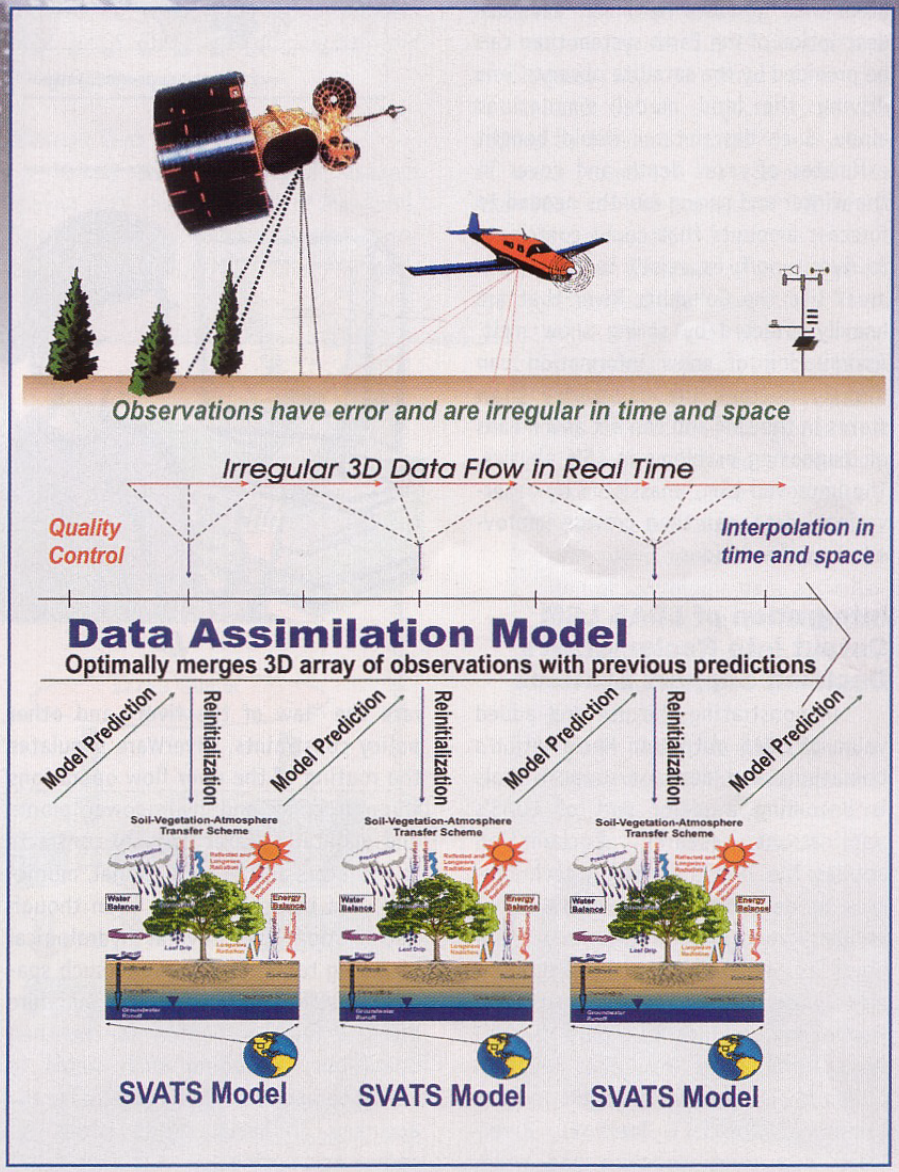

Figure 2. *Data assimilation merges observations with LSM forecasts to maximize spatial and temporal coverage and to produce optimal estimates of land surface states, including surface soil temperature and soil moisture.*